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Defense National Stockpile
Holding Costs

OPERATIONS RESEARCH AND ECONOMIC ANALYSIS OFFICE

DEPARTMENT OF DEFENSE

DEFENSE LOG'STICS AGENCY

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Defense National Stockpile Holding Costs

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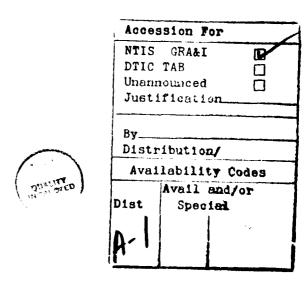### ALEXANDRIA, VIRGINIA 22304-6100

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FOREWORD

This report documents the development of annual holding costs for the Defense National Stockpile (DNS) commodities. This study was performed at the direction of the Assistant Secretary of Defense for Production and Logistics and the Director of the Defense Logistics Agency.

Three annual cost-to-hold factors are presented for use in analyses with different levels of specificity: a marginal cost-to-hold factor that would be applicable to a small portion(s) of the DNS, the selling or buying of which would impact only direct operating costs with no changes in space requirements or overhead costs; a total cost-to-hold factor that would be applicable for large scale changes that impact the overhead structure of the DNS; and a cost-to-hold factor for commodities that are currently excess which uses specific storage costs rather than an overall average. Based on the treatment of market gain, the actual holding costs for FY 89 were estimated to range from $356.3 million to $747.3 million.

CHRISTINE GALLO
Deputy Assistant Director
Policy and Plans

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I. INTRODUCTION

A. Background

The Defense National Stockpile (DNS) consists of quantities of materials or commodities that may be required but may not be otherwise available in times of national emergency. The buying, holding and selling of these commodities are tightly controlled by public law, the Congress, and the State Department. Over time, a Transaction Fund (T-Fund) has been established largely through proceeds from the sale of authorized excess commodities. A small portion of the T-Fund originated in the distant past as a budget item. For practical purposes, the total of the T-Fund and the dollar value of the commodities represent a closed system wherein changes to that total are influenced by the market values of the commodities being held, bought and/or sold. The amount of commodities bought and held in the DNS is based on requirements and not any Economic Order Quantity (EOQ) computation. The inherent philosophy is risk avoidance rather than an economic decision.

During a discussion of the DNS operations, the Assistant Secretary of Defense for Production and Logistics (ASD(P&L)) asked what the holding costs were for the DNS, to include the investment or opportunity cost. Such a holding cost or rate, other than the operating cost of the DNS, was not immediately available.

There is no commercial equivalent to the DNS. Commodity traders, for instance, deal mainly in futures, thereby avoiding physical holding costs. Only 5 percent of the reported commercial transactions result in physical deliveries and virtually none of these involve long term storage.

The DLA Directorate of Stockpile Management (DLA-N) subsequently requested that the DLA Operations Research and Economic Analysis Management Support Office (DLA-DORO) develop the costs to hold commodities in the DNS.

B. Purpose. The purpose of this study was to develop factors to estimate the costs to hold commodities in the DNS for the use of the DNS management and OASD(P&L).

C. Objectives. The specific objectives of the study were to:

1. Develop a marginal cost-to-hold factor that would be applicable to a small portion(s) of the DNS, such as ten tons of ore, the selling or buying of which would not impact operating costs other than direct operating costs. That is, no changes in the amount of space required or overhead costs would be incurred.

2. Develop a total cost-to-hold factor that would be applicable for large scale changes that impact the overhead structure of the DNS, such as selling of the total stockpile.

3. Develop a cost-to-hold factor that would apply to commodities which are in excess of current requirements. This factor would be based on specific storage costs rather than an overall average.

D. Limitations

1. Although cost-to-hold factors may have many uses, they are primarily used in determining EOQs by trading off cost-to-order against cost-to-hold to determine the least cost quantity to order. Buying and selling commodities for the DNS are not currently based on EOQ but on total requirement.

2. These cost-to-hold factors are based on FY 85 through FY 89 data and will require annual re-examination.

3. Large scale changes in the level of commodities held, the organization, operating practices, or budget levels of DLA-N may change the factors significantly.

4. The accuracy of the cost-to-hold factors is limited by the lack of data concerning the date of purchase of commodities on hand. This hampered the evaluation of the impacts of inflation on long range changes in commodity values. In addition, since the date of acquisition was not available, the length of time various commodities were held in the DNS was derived by subject matter expert estimates.

II. METHODOLOGY

A. Data. Data for this study were provided by DLA-N from budgetary and other DNS records for FY 85 through FY 89. Summaries of the data provided for use in the study appear in the appendices.

B. Approach. The basic approach for this analysis was taken from DODI 4140.39, Procurement Cycles and Safety Levels of Supplies for Secondary Items. Although the approach outlined by the instruction pertains specifically to non-reparable secondary items, the basic concept is applicable to the DNS with minor adjustments. Total cost-to-hold is made up of investment cost, storage cost, cost of obsolescence, and cost of other losses.

1. Investment Cost. Each dollar invested in DNS commodities is viewed as replacing a dollar of investment in the private sector. That is, a dollar returned to the Treasury from a public investment represents a dollar that is not removed from the population through borrowing or taxation. If the Stockpile is sold and the proceeds are returned to the Treasury, they can be used for other Government purposes. Conceptually, this reduces the amount of money required to be removed from the public through taxation or borrowing. Money thus removed is considered to be money that would have been otherwise invested by the public at various rates of return, ranging from none (or possibly negative) to very large returns, for instance on capital investments for large corporations. As one can imagine, it is very difficult to get an accurate estimate of a rate of return that would represent all the various investment possibilities.

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Various DLA and DoD directives and instructions specify an annual investment charge of 10 percent be used in the analysis of Defense investments. It should be noted that the proceeds from the sale of a stockpiled commodity do not go to the general Treasury, but return to the T-Fund as required by law. In order to avoid investment cost, funds would have to be returned to the Treasury instead, thereby reducing the combined total dollar value of the commodities stored and the T-Fund.

    2. Storage and Management Cost. This cost represents the actual DNS budget dollars that are spent in holding, buying, selling and managing the commodities. The storage and management cost divided by the value of the commodities stored yields the storage and management cost factor.

    3. Cost of Obsolescence. This "cost" may actually be a profit in the DNS operation. Assume that the Government bought some commodity 30 years ago that is not readily available in the marketplace. It would be expected that the market price would rise and, if the commodity were sold as excess to Defense needs, a "profit" would result if the proceeds exceeded the cost of the commodity and the associated holding costs. The proceeds from sales for 5 years (FY 85 - 89) were netted against the original costs of the goods and the physical holding costs and divided by the total dollar value of the commodities held to derive an expected value (in percent of dollar value) of a market gain/loss. This factor is flawed in that current records do not indicate date of purchase. Therefore, the impact of inflation cannot be accounted for with any degree of accuracy. The inherent assumption used in this approach is that actual sales provide a better measure of market value than other estimates.

    4. Cost of Other Losses. The market value of commodities through theft and other causes, divided by the total dollar value of the commodities, yields a cost factor for other losses. The total dollar value of commodity losses for the 5 years under study was approximately $110 thousand. When divided by the dollar value of the commodities in the Stockpile, the value approaches zero (.00001). For the purposes of this analysis, the factor for other losses is taken to be zero.

    5. The sum of the above factors represents the cost-to-hold factor. Holding costs are assumed to have a linear relationship to the dollar volume of commodities stored and the factors are expressed as the holding cost per year per dollar of commodity stored.

III. RESULTS

A. Marginal Cost-to-Hold

    1. Investment costs were taken as 10 percent as discussed in paragraph IIB1, above.

    2. The storage and management cost factor was developed by dividing the direct operating costs (excluding any T-Fund transactions) by the dollar value of the commodities stored. In the absence of specific data, DNS operating costs at the Zone level and below were assumed to be

variable and directly related to the dollar value of commodities stored, whereas Headquarters level costs were considered fixed.

$$\text{Storage and Mgmt Cost Factor} = \frac{\text{Avg Direct Operating Costs}}{\text{Avg Dollar Value of Commodities}}$$

$$\text{Storage and Mgmt Cost Factor} = \frac{\$31.3 \text{ M}}{\$9,385.6 \text{ M}} = .003$$

3. The market gain factor attributed to market value increases of commodities held was derived by:

$$\text{Market Gain Factor per Year} = \frac{\text{Gain}}{\text{Years Held X Original Cost}}$$

Gain = Commodity Sales - Original Cost - Holding Cost

Holding Cost = Avg Commodity Value X Storage & Mgmt Factor X Years Held

$$\text{Avg Commodity Value} = \frac{\text{Commodity Sales + Original Cost}}{2}$$

Since data on how long a commodity has been held in the DNS were not available, an estimate of 30 years was obtained from DLA-N subject matter experts. Substituting numbers in the above formulas gives:

$$\text{Avg Commodity Value} = \frac{\$414.9 \text{ M} + \$198.3 \text{ M}}{2} = \$306.6 \text{ M}$$

Holding Cost = $306.6 M X .003 X 30 Years = $27.6 M

Gain = $414.9 M - $198.3 M - $27.6 M = $189.0 M

$$\text{Market Gain Factor per Year} = \frac{\$189.0 \text{ M}}{30 \text{ Years X } \$198.3 \text{ M}} = .032$$

Note that this factor is a gain and when summed with the other factors will be represented as a negative number.

4. The marginal cost-to-hold factor is then:

Investment Cost	.100
Storage & Mgmt	.003
Market Gain	-.032
Other Losses	.000
Marginal Cost-to-Hold	.071

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B   **Total Cost-to-Hold.** The total cost-to-hold factor varies from the mart .nal cost-to-hold factor only slightly due to increased storage and management costs (i.e., overhead) being included. As discussed earlier, large scale changes will change the operating costs in the DNS Headquarters.

1. The storage and management cost factor for the total cost-to-hold was developed as follows:

$$\text{Storage and Mgmt Cost Factor} = \frac{\text{Avg Total Operating Costs}}{\text{Avg Dollar Value of Commodities}}$$

$$\text{Storage and Mgmt Cost Factor} = \frac{\$36.3 \text{ M}}{\$9,385.6 \text{ M}} = .004$$

2. The market gain factor attributed to market value increases of commodities held for the total cost-to-hold factor was derived using the same method as above.

Holding Cost = $306.6 X .004 X 30 Years = $36.8 M

Gain = $414.9 M - $198.3 M - $36.8 M = $179.8 M

$$\text{Market Gain Factor per Year} = \frac{\$179.8 \text{ M}}{30 \text{ Years X } \$189.3 \text{ M}} = .030$$

3. The total cost-to-hold factor is then:

Investment Cost	.100
Storage & Mgmt	.004
Market Gain	-.030
Other Losses	.000
Total Cost-to-Hold	.074

C.   **Cost-to-Hold for Excess Commodities.** The cost-to-hold factor for excess commodities varies from the marginal cost-to-hold in that it used specific excess commodity storage costs rather than an overall average. For the cost-to-hold factor for excess commodities, all cost factors were the same as for the marginal cost-to-hold.

1. The storage portions of the direct operating costs were replaced with the storage costs for the excess commodities. The remainder of the costs were prorated in the same proportion as excess commodities were to total commodities.

$$\text{Storage and Mgmt Cost Factor} = \frac{\text{Avg Excess Commodities Operating Costs}}{\text{Avg Dollar Value of Excess Commodities}}$$

Storage and Mgmt Cost Factor $= \dfrac{\$7.3 \text{ M}}{\$2,200.3 \text{ M}} = .003$

2. The cost-to-hold factor for excess commodities is then:

Investment Cost	.100
Storage and Mgmt	.003
Market Gain	-.032
Other Losses	.000
Cost-to-Hold for Excess	.071

D. <u>Summary of Results</u>. A summary of the results based on market value is presented in Table 1. Notice that the three factors vary so little as to be within the range of error of the data used in the study.

Table 1

<u>SUMMARY OF COST-TO-HOLD FACTORS BASED ON MARKET VALUE</u>

	Marginal	Total	Excess
Investment Cost	.100	.100	.100
Storage and Mgmt	.003	.004	.003
Market Gain	-.032	-.030	-.032
Other Losses	.000	.000	.000
Cost-to-Hold factor	.071	.074	.071

E. <u>Sensitivity Analysis</u>. As discussed earlier, the use of .10 as the investment cost factor is dictated by DOD policy. This factor is sometimes viewed as rather arbitrary. Therefore the impact of changes in this factor on the results was reviewed. The relationship is direct in that a change in the investment factor changes the results by that same amount. For example, an investment rate of eight percent, instead of 10 percent, results in a marginal cost-to-hold factor of .051 versus .071.

F. <u>An Alternative Approach</u>. It can be viewed that market gain doesn't impact holding cost until commodities are actually sold. In this vein, all calculations are based on the cost of the commodities, ignoring any potential value caused by market gain until the year of sale. If one were to follow this line of reasoning, then the investment cost remains at .10, but the storage and management factor changes to .009 when based on commodity cost instead of market value, yielding a marginal cost-to-hold factor of .109. The total cost-to-hold factor and the excess cost-to-hold factor are approximately .110. Applied to the average cost of the commodities held, $3.6 billion, the total cost-to-hold factor estimates a gross holding cost for the Stockpile of $396.0 million per year. The gain actually realized from sales during FY 85 through FY 89 was $198.3 million, or $39.7 per year, and when credited against the annual gross holding cost, gives an annual net holding cost of $356.3 million.

IV. CONCLUSIONS. Based on the treatment of market gain, the holding costs for a commodity in the Stockpile range from 7.1 percent of the market value of the commodities to 10.9 percent of the cost of the commodities for each year held in storage. Our best estimate of the actual total Stockpile holding cost for FY 89, therefore, ranges from $356.3 million (based on cost) to $747.3 million (based on market value). The holding cost for excess commodities amounts to $134.6 million (based on market value). Care must be exercised in the application of any factor for Stockpile holding cost since the decision to stockpile an item falls more clearly into a risk avoidance category, rather than a purely economic decision.

V. RECOMMENDATIONS

o   That the cost-to-hold factors be updated on an annual basis, if they are to be used on a recurring basis.

o   That changes be instituted in the DNS accounting system to capture the date of purchase of commodities.

APPENDIX A

Market Value of Commodities

Millions of Dollars

End of FY	Total Market	Inventory Cost	Total Market	Excess Cost	Auth Market	Excess Cost
85	9,978.4	3,389.0	3,091.6	861.0	586.1	139.6
86	8,593.7	3,708.4	1,875.6	812.9	412.3	108.5
87	9,004.1·	3,660.0	2,136.5	748.7	433.8	108.1
88	9,253.5	3,407.0	2,001.9	704.6	523.5	105.4
89	10,098.2	3,644.1	1,896.1	637.5	457.2	184.8
AVG	9,385.6	3,561.7	2,200.3	752.9	482.6	129.3

APPENDIX B

Commodity Sales

Millions of Dollars

FY	Market	Cost
85	67.9	37.7
86	65.1	37.9
87	131.2	57.3
88	81.2	41.6
89	69.5	23.8
Total	414.9	198.3

APPENDIX C

Defense National Stockpile Obligations

Millions of Dollars

Fiscal Year	HQ DNS	Zones Total	Total
85	4.9	31.2	36.1
86	5.0	30.3	35.3
87	5.0	30.4	35.4
88	5.2	32.4	37.6
89	5.2	32.0	37.2

APPENDIX D

Cost to Store Excess Commodities

Millions of Dollars

FY	Authorized	Total
85	3.1	2.8
86	3.1	2.8
87	3.2	2.9
88	3.2	2.9
89	3.3	2.9

APPENDIX E

Stockpile Transaction Fund

Millions of Dollars

	FY85	FY86	FY87	FY88	FY89
Unobligated Start of FY	<122.9>	391.3	596.2	577.9	505.3
Increases	523.2	205.1	71.2	46.5	116.2
Obligations	9.0	0.2	89.5	119.1	172.6
Unobligated End of FY	391.3	596.2	577.9	505.3	448.9

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